

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes	
Biotic Integrity	Terrestrial Ecosystems	Community Vegetation	Monitor effects of management on native communities	T10	Recovery/Change of Native Vegetation with Invasive Alien Invertebrate Control	Are native plant species recovering where invasive invertebrates are controlled? What are trends in plant community composition and structure following invasive invertebrate control?	Transects, plots	species composition, vigor, size classes, density, Cover, abundance & distribution of alien inverts & native pollinators, flower & seed production	1.8	
			Monitor effects of biocontrol on native and invasive species	T11	Invertebrate Biocontrol of Plants	What is the long-term impact/efficacy on populations of blackberry, passionflower, & other pests? Are non-target plants, especially natives, being affected?	Plots & transects for plants	Infestation rates	1.7	
		Population	Monitor effects of biocontrol on native and invasive species	T12	Plant Pathogen Biocontrol of Plants	What is the impact/efficacy on populations of control target? Are non-target species being attacked?	Plots & transects	Infestation rates	1.6	
			Monitor community dynamics, structure, function, and composition	T18	Terrestrial Invertebrate Biodiversity	What are trends in distribution and abundance of hyper-diverse groups w/in parks?	Population surveys, transects, plots	Diversity, evenness, endemism	2.9	
		Community	Monitor effects of management on native communities	T20	Recovery/Change of Native Invertebrates Communities with Native Plant Restoration	What native species are recolonizing restored areas? Which ones are not?	Transects, plots	abundance, Presence, trends of selected species or groups	2.5	
			Monitor effects of management on native communities	T21	Recovery/change of Native Wildlife and habitats (including wetlands) with restoration of native vegetation	What are trends in plant community composition and structure resulting from outplanting and seed-sowing activities? What is the response of native vertebrate and invertebrate populations to plant community restoration? What are priority plant species that should be restored?	Transects, plots (monitoring of areas where seeds have been broadcast and native species outplanted)	size classes, vigor, species composition, seedling recruitment, growth rates, Cover, animal reproductive success, animal popn size, animal popn growth rates, survivorship, density	3.2	
		Consumers	Monitor effects of biocontrol on native and invasive species	T22	Invertebrate Biocontrol of Invertebrates	What is the impact of biocontrol agents on native moths, beetles, & parasitoids? What is the impact/efficacy on target populations?	Population surveys, rearing	Infestation rates	1.7	
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	T25	Invertebrate Charismatic or Species of Concern	Are distribution, abundance, other population characteristics, or habitat changing? Determine population levels over time.	Population surveys	Abundance / density, demographics, distribution	3.2	
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	T28	Terrestrial Invertebrates Associated with Habitat Quality	What are trends in invertebrate indicator species?	Population surveys	abundance, distribution, demographics	2.7	
			Monitor extent and response to treatment of established invasive species	T29	Terrestrial Invertebrate Species Protection (T, E, S-o-C Species)	Are distribution, abundance, other population characteristics, or habitat changing?	Mapping, plots, population surveys	abundance, distribution, demographics	2.9	
			Monitor extent and response to treatment of established invasive species	T33	Established Alien Species - Invasive Terrestrial Invertebrate Pests of natural systems	How effective is control? What are the abundance, distribution, and seasonal and year-to-year variations in populations? What are trends in impact?	Transects, plots, population surveys	abundance, distribution, demographics	2.4	
	Freshwater Ecosystems	Population	Monitor extent and response to treatment of established invasive species	T35	Established Alien Species - Terrestrial Invertebrate Pests (agricultural)	Monitor population fluctuations to determine when additional control actions are needed	Population surveys	Infestation rates of native and alien fruits	1.8	
			Monitor extent and response to treatment of established invasive species	T36	Established Alien Species - Terrestrial Invertebrate Pests (human structures)	Characterize extent of impact invertebrate pests are having on historical and other culturally significant structures?	Periodic sampling of structures	Infestation rates	1.9	
			Monitor occurrence of non-established (incipient) invasive species	T39	Alien Incipient Invasives - Terrestrial Invertebrates	Is species present, if so what is the nature and extent of infestation? What are the most effective strategies for detecting and preventing new invasives species? Where should efforts be focused? What are potential impacts?	Passive surveillance and follow-up on reports; education, outreach, and public reporting; surveys in high-risk sites	distribution, Presence/ absence, rapid assessment of extent of infestation	2.2	
		Community	Monitor changes in cave communities	T41	Cave & lava tube communities	Are cave (biotic) communities changing? What are temporal trends?	Population surveys, root type and abundance	abundance, distribution, demographics	2.0	
Freshwater Ecosystems	Consumers	Community	Monitor community dynamics, structure, function, and composition	F2	Aquatic and Riparian Species (vertebrate and invertebrate) Biodiversity	Are there long-term changes in selected aquatic native communities?	Population surveys, transects	Abundance and trends of selected species or groups	3.5	

Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials (http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm)

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
			Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
Physical / Chemical Environment	Climate & Air Quality		Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
	Soil, Water, & Nutrient Dynamics		Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
	Water Quality		Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
	Geology	Hazards	Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
		Landforms	
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
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			Cave Systems Community Monitor changes in cave communities
		Freshwater Ecosystems	Producers Monitor community composition, structure, and productivity
			Community Monitor community dynamics, structure, function, and composition
			Monitor disease incidence and impacts, especially on native species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
	Marine Ecosystems	Benthic	Landscape Monitor patterns of distribution & extent of community types
			Community Monitor community dynamics, structure, function, and composition
			Population Track community and population trends in harvested fisheries / collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
		Water column (motile)	Track community and population trends in harvested fisheries species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
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